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Applicant: Applied Physics Institute of the Academy of Sciences of the AMoldovian SSR@*
[* Translator=s note: i.e. now Republic of MOLDOVA]
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Prior art documents: U.S.S.R. Author=s Certificate No. 673412, IPC: B 23 H 3/00, 1979.
[Title in Russian of the object of the invention:] Sposob elektrokhimicheskoy obrabotki metallov bipolyarnym tokom

METHOD FOR THE ELECTROCHEMICAL MACHINING OF METALS BY MEANS OF BIPOLAR ELECTRIC CURRENT

(57) The invention pertains to the machine-building industry, in particular to electrochemical machining methods* by means of bipolar electric current [*Translator=s note: methods for the removing of metal by passing current between an electrode and a workpiece in the presence of an electrolyte]. It is an object of the invention to reduce the surface roughness of the surface, which is being machined, by improving the conditions of depassivation. Over the course of action of the anode pulse, the metal dissolves while passivating layers are concurrently generated. Over the course of the cathode pulse, there takes place depassivation of the surface, which is being machined, and, on account of the separation of hydrogen in the subelectron layer, there occurs alkalization of the

electrolyte, which facilitates the depassivation process. After the effect of the cathode pulse is terminated, and until the supply of the subsequent anode pulse, a pause is maintained, over the course of which an additional and complete depassivation of the surface takes place. The duration of the pause is selected between 0.5 to 2 of the duration of the cathode pulse.

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The invention pertains to electrochemical machining methods, and may be used for the machining of metals, exhibiting a tendency towards passivation.

It is an object of the invention to improve the efficiency or production rate of the process and to reduce the roughness of the surface, which is being machined, on account of using the alkalization effect of the electrode-to-electrode interval.

The proposed method is carried out as follows.

Over the course of the action of the anode pulse, there takes place a dissolution of the metal, while passivating layers are concurrently formed. After the anode pulse, the surface is subjected to the effect of a cathode pulse, and depassivation of the surface, which is being machined, takes place. At the same time, due to the separation of hydrogen, the electrolyte in the subelectron layer becomes alkalized. After the effect of the cathode pulse is terminated, and prior to the feeding of the subsequent anode pulse, there is maintained a pause, over the course of which an additional and complete depassivation of the surface takes place.

Due to the high values of the hydrogen-ion concentration, pH, a reaction takes place, and a chemical dissolution of the passivating film takes place during the pause between the cathode

and anode pulses. The greater the value and the duration of the cathode-pulse amplitude, the greater the pH-value achieved in the subelectron layer, and the period, and the shorter the interval in which the dissolution of the passivating film occurs.

Due to the complete liberation of the surface, which is being machined, from passivating film, a large part of the energy of the subsequent anode pulse is utilized to directly dissolve the metal, as a result fo which the efficiency of the process and the quality of the surface obtained are improved. As a consequence of te chemical dissolution, of the passivating film during the pause, the energy of the cathode pulse can be decreased, which provides an opportunity to reduce the dissolution of the cathode-tool, and to improve the accuracy of the shaping or forming.

Therefore, the value of the lower limit of the duration of the pause is selected by taking into account the fact that over the course of the effect of the pause, when cathode pulses of a considerable amplitude are used, an alkalization of the electrolyte takes place to pH-values, which suffice for the dissolution of passivating films. When cathode pulses, having minor amplitudes, are used, the duration of the pause should be increased to the upper limit, i.e. to 2 durations of the cathode pulse.

E x a m p l e 1. Electrochemical machining of tungsten [wolfram] was carried out in a solution of sodium chloride, having a concentration of 100 g/l. The amplitude of the voltage of the anode and cathode current pulses is 25 volts while their duration is 2 ms. The pause between the cathode and anode was not maintained. The velocity of removal constituted 0.15 mg/Kl [kiloliters], while the surface roughness R_z = 25 μm.

E x a m p l e 2. Tungsten was electrochemically machined in a solution of sodium chloride, having a concentration of 100 g/l. The amplitude of the voltage of the anode pulses was

50 volts, while the amplitude of the voltage of the cathode pulses was 15 volts. The duration of the anode and cathode pulses constituted 4 ms, while the duration of the pause was 2 ms.

In doing so, the velocity of removal was 0.18 mg/Kl, while the surface roughness was $R_z = 15$ μm.

E x a m p l e 3. Tungsten was electrochemically machined in a solution of sodium chloride, having a concentration of 100 g/l. The amplitude of the voltage of the anode pulses was 50 volts, while the amplitude of the voltage of the cathode pulses was 15 volts. The duration of the anode and cathode pulses constituted 4 ms, while the duration of the pause was 8 ms.

The velocity of removal was 0.205 mg/Kl, while the surface roughness was $R_z = 0.2$ μm.

E x a m p l e 4. Tungsten was electrochemically machined in a solution of sodium chloride, having a concentration of 100 g/l. The amplitude of the voltage of the anode pulses was 50 volts, while the amplitude of the voltage of the cathode pulses was 15 volts. The duration of the anode and cathode pulses constituted 4 ms, while the duration of the pause was 10 ms.

The velocity of removal was 0.197 mg/Kl, while the surface roughness was $R_a = 0.23$ μm.

C L A I M

Method for the electrochemical machining of metals by means of bipolar current, whereby after the cathode pulse, a pause is maintained, c h a r a c t e r I z e d in that with an aim of improving

the efficiency and the quality of the machining, the duration of the pause is selected within the limits o.5 to 2 of the duration of the cathode pulse.

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